Characterization of Novel Polymer Electrolytes for Lithium-ion Secondary Batteries Ⅱ: Annealing Effect of P(VdF-HFP)/P(EO-EC) Blend Membranes

Jae-Deok Jeon* and *Seung-Yeop Kwak

School of Materials Science and Engineering, Seoul National University,

San 56-1, Shinlim-dong, Kwanak-ku, Seoul 151–744, Korea

In order to overcome the problems inevitably caused by the solvent leakage and evaporation without scarifying the ionic conductivity of gel-type electrolytes, we have recently studied the solvent-free electrolytes using the immersion of poly(ethylene oxide-*co*-ethylene carbonate) [P(EO-EC)] into porous poly(vinylidenefluoro-co-hexafluoropropylene) [P(VdF-HFP)]/P(EO-EC) blend membranes. However, it still has a drawback ascribed to the addition of viscous P(EO-EC) to prepare blend membranes, thereby resulting in gradual decrease of mechanical properties.

In this study, for the purpose of improving the mechanical properties of immersion system electrolytes, porous P(VdF-HFP)/P(EO-EC) blend membranes were first annealed at 110 ^{o}C for 2 h. Then, the viscous P(EO-EC), playing a role of ion conduction, was immersed and filled into the pores of the membranes instead of the conventional solvent such as ethylene carbonate (EC) or propylene carbonate (PC).

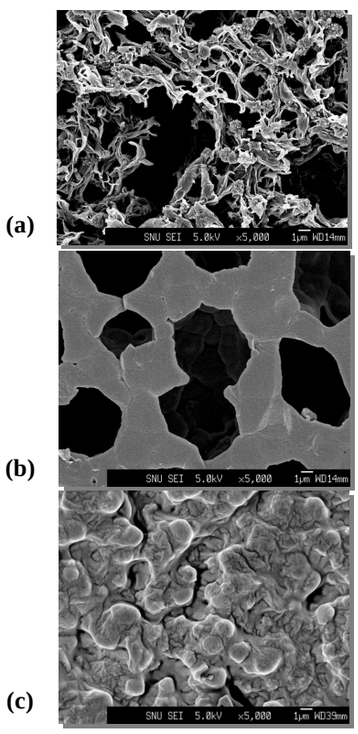

Figure 1. SEM micrographs of non-annealed (a), annealed (b), and immersed (c) membranes for the blend composition of 60/40

Figure 3. Ionic conductivity of annealing and immersion system electrolytes

As shown in Fig. 1, the annealed membranes (Fig. 1b) had more well-defined and hard cross-linked pore structure than the non-annealed membranes (Fig. 1a). The mechanical properties such as tensile strength and modulus (Fig. 2) were remarkably improved due to annealing effect. Furthermore, the ionic conductivity, σ of the annealing system electrolytes reached a maximum value of ~ 4×10^{-5} S/cm at the blend composition of 60/40 and showed nearly similar values in comparison to that of immersion system electrolytes (Fig. 3).

Overall, it is concluded that the improvement of mechanical properties is accomplished by annealing without the deterioration of the electrochemical performance.

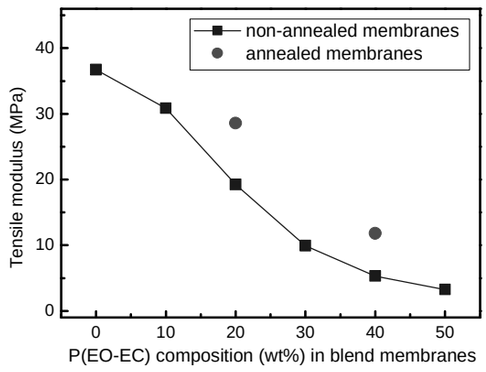

Figure 2. Tensile modulus of porous membranes